



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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www.agronomyjournals.com

2024; SP-7(12): 279-281

Received: 15-09-2024

Accepted: 19-10-2024

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Effect of integrated nutrient management on quality and economics of wheat (*Triticum aestivum* L.)

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DOI: <https://doi.org/10.33545/2618060X.2024.v7.i12Se.2162>

Abstract

A field experiment was conducted at Agriculture Farm, Glocal School of Agricultural Science, Saharanpur, Uttar Pradesh during *rabi* season of 2015-16 to study the effect of integrated nutrient management on quality and economics of wheat. The results reveal that the application of 100% RDF + FYM 2 t ha⁻¹ + VC 1 t ha⁻¹ recorded significantly higher protein content in wheat grain along with gross returns. However, higher net returns and B:C ratio were recorded with application of 75% RDF + FYM 2 t ha⁻¹ + VC 1 t ha⁻¹ under the agro-climatic condition of Saharanpur, Uttar Pradesh.

Keywords: Wheat, Vermicompost, spike length, tillers, net returns and protein

Introduction

Agriculture is the primary source of food and nutrients to sustain human life. There are various crops which provide the major food demand of the people globally; Wheat (*Triticum aestivum* L.) is responsible up to 70% of daily caloric intake of the population living in rural regions and an important source of zinc in the developing world (Cakmak, 2008) [1]. Wheat is one of the leading food crops of world farming and occupies significant position among the cultivated cereals (Waines and Hegde, 2003) [16]. Cultivation of wheat has been the symbolic of green revolution that is why some times green revolution is also termed as Wheat revolution. Wheat forms the main source of protein and calories to a large section of the Indian population and contributes significantly for food and nutritional security to the people of the country. The story of green revolution in India is primarily a tale of wheat revolution. No other major crops in India have achieved as high rate of growth in production as wheat has done (Kantwa *et al.*, 2015) [7]. It is cultivated in almost all countries; the major wheat producing countries are China, India, USA, Russia, France and Australia. Worldwide, wheat provides nearly 55% of the carbohydrates and 20% of the food calories consumed globally (FAO, 2017) [4]. Wheat is used by human beings in form of flour for making chapatias, semolina and pasta products. It is also used for preparation of bread, biscuits, cookies, noodles, dalia, maida, vermicelli, etc. Wheat straw is also used for the animal feed as fodder and for packaging materials. The wheat contains nearly 70 per cent carbohydrates, 12 per cent protein, 1.7 per cent fat, 2.7 per cent minerals, 2 per cent fiber and 12 per cent moisture (Gupta *et al.*, 2002; Shewry and Hey, 2015) [6, 12]. However, the productivity of the crop in the Uttar Pradesh is lower than the potential yield. The wheat productivity is highly variable within different agro-ecologies of India, due to variable climatic conditions, moisture stress, genotypes, imbalance fertilizer use, seeding time and practices and other management practices (Kantwa *et al.*, 2015) [7]. Wheat compares well with other important cereals in its nutritive value.

In modern agriculture, keeping in mind status of the soil health, it is well recognized that neither organic manures nor chemical fertilizers individually can supplement the balanced amount of nutrients required by the plant to sustain production. Area under cultivation of wheat cannot be stretched beyond certain limits only possibility is the maximization of production per unit area per unit time and maintenance of soil fertility (Ramesh *et al.*, 2009) [11]. Long term studies being carried out at several locations in India indicated that application of all the needy nutrients

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through chemical fertilizers have deteriorating effect on soil health leading to unsustainable yields (Eid *et al.*, 2006)^[3]. Under these circumstances integration of chemical and organic sources and their management have shown promising results not only in sustaining the productivity but have also proved effective in maintaining soil health and enhanced nutrient use efficiency (Chesti *et al.*, 2013)^[2].

Wheat is nutrient exhaustive and had resulted in decline of soil organic carbon and deteriorating soil health in general for sustainability of the system well as the overall soil health, organic sources play an important role. To curb this trend of declining yield, there is a need to adopt the concept of integrated nutrient management. The appropriate combination of mineral fertilizer, organic manures, compost or bio-fertilizers along with incorporation of micronutrients can be feasible and viable to sustain agriculture as a commercial and profitable means ensuring high yield of crop without deterioration in quality of the produce.

Nitrogen occupies a conspicuous place in plant metabolism. Nitrogen fertilizer is known to effect on the various growth attributes, yield attributes and yield. Appropriate management of N fertilization has the potential to improve the yield and nutritional quality of wheat (Shi *et al.*, 2010)^[13]. Phosphorus is of paramount importance for increasing yield and energy transfer in the living cells by means of high energy phosphate bonds of ATP. Thus, it is considered important for formation and translocation of carbohydrates, fatty acids, glycerids and other essential intermediate compounds. Potassium (K) uptake by crop is at par or higher than nitrogen (N) uptake. Wider nutrient consumption ratio is aggravating the problem of negative nutrient balance in soils, also for K, which plays a major role in influencing the quality parameters. The farmers apply FYM @ 10 t ha⁻¹ but certainly they face a challenge especially in deciding the quantity of vermicompost. Therefore, it is right time to evaluate the feasibility and efficacy of these manures in improving and building up of soil fertility in combination with chemical fertilizers. Thus, to maintain soil health, an integrated nutrient management approach involving vermicompost and inorganic sources has to be standardized so as to compare the efficacy of different sources of organic manures with recommended level of FYM/fertilizers (Upadhyay *et al.*, 2011)^[14].

Materials and Methods

An experiment was conducted during *rabi* season of 2015-16 at Agriculture Farm, Glocal School of Agricultural Science, Saharanpur, Uttar Pradesh. The soil was loamy sand in texture having a pH of 8.3 (Alkaline), EC 1.1 (dS m⁻¹), low in organic carbon (0.14 %) and low available nitrogen (132.7 kg ha⁻¹), medium in available phosphorus (16.3 kg ha⁻¹) and low in available potassium (150.4 kg ha⁻¹). The experiment was conducted in randomized block design with replicate thrice consisted of ten nutrient management treatments viz. (T₀) Control, (T₁) 50% RDF (60-30-30 kg N-P-K ha⁻¹), (T₂) 75% RDF (90-45-45 kg N-P-K ha⁻¹), (T₃) 100% RDF (120-60-60 kg N-P-K ha⁻¹), (T₄) 50% RDF + FYM 3 t ha⁻¹, (T₅) 75% RDF + FYM 3 t ha⁻¹, (T₆) 100% RDF + FYM 3 t ha⁻¹, (T₇) 50% RDF + FYM 2 t ha⁻¹ + Vermicompost 1 t ha⁻¹, (T₈) 75% RDF + FYM 2 t ha⁻¹ + Vermicompost 1 t ha⁻¹ and (T₉) 100% RDF + FYM 2 t ha⁻¹ + Vermicompost 1 t ha⁻¹. The treatments were allocated randomly to each plot. Urea, di ammonium phosphate and

murate of potash were used as a source of nitrogen, phosphorus and potassium. The crop was fertilized as per treatment and a full dose of phosphorus and potassium as basal and nitrogen applied as basal as well as top dressing. Manures were applied one month before sowing. HD-2967 variety of wheat was used as a test crop. Other crop management methods were accompanied as per the recommendation of the area.

Statistical analysis and interpretation of data: Data recorded on various parameters of wheat crop in the experiment was subjected to analysis by using Fisher's method of analysis of variance (ANOVA) and interpreted as outlined by Gomez and Gomez (1984). The levels of significance used in 'F' and 't' test was p= 0.05. Critical difference values were calculated where F test was found significant.

Results and Discussion

Integrated nutrient management practices exerted significant effect on quality and economics of wheat. The data pertaining to protein content in grain are presented in Table 1. Among the treatments, significantly higher protein content (11.31%) was recorded with application of 100% RDF + FYM 2 t ha⁻¹ + VC 1 t ha⁻¹ which was statistically at par with 75% RDF + FYM 2 t ha⁻¹ + VC 1 t ha⁻¹ over rest of the treatments (Table 1). The increase in protein content with increasing nitrogen fertilization might be due to utilization of photosynthetic material for protein synthesis. These results are in close agreement with those of Verma *et al.* (2010)^[15]. The reason given by them that application of nitrogen greater proportion of photo-synthase was diverted to protein synthesis in grains. This finding is in conformity with the findings of Neigh *et al.* (2013)^[8].

A perusal of data in Table 2 indicate that maximum cost of cultivation (₹ 21638 ha⁻¹) and gross returns (₹ 92060 ha⁻¹) were recorded with application of 100% RDF + FYM 2 t ha⁻¹ + VC 1 t ha⁻¹ during in the investigation. While, application of 75% RDF + FYM 2 t ha⁻¹ + VC 1 t ha⁻¹ fetched maximum net returns (₹ 70671 ha⁻¹) and B: C ratio of the magnitude 3.41 followed by 100% RDF + FYM 2 t ha⁻¹ + VC 1 t ha⁻¹ during course of study. Similar result was also reported by Ram and Mir (2006)^[10] and Pandey *et al.* (2006)^[9]. The result on current studies vindicated that cost of cultivation was marginally higher when the nutrients were applied in combination. Due to higher grain and straw yields, the net income and benefit cost ratio was also higher with use of integrated nutrient sources. This finding is in conformity with the findings of Neigh *et al.* (2013)^[8].

Table 1: Protein content (%) in wheat grain as influenced by integrated nutrient management practices

Treatments	Protein content (%)
Control	9.00
50% RDF (60-30-30 kg N-P-K ha ⁻¹)	9.88
75% RDF (90-45-45 kg N-P-K ha ⁻¹)	10.06
100% RDF (120-60-60 kg N-P-K ha ⁻¹)	10.50
50% RDF + FYM 3 t ha ⁻¹	10.31
75% RDF + FYM 3 t ha ⁻¹	10.50
100% RDF + FYM 3 t ha ⁻¹	10.69
50% RDF + FYM 2 t ha ⁻¹ + VC 1 t ha ⁻¹	10.81
75% RDF + FYM 2 t ha ⁻¹ + VC 1 t ha ⁻¹	10.94
100% RDF + FYM 2 t ha ⁻¹ + VC 1 t ha ⁻¹	11.31
S.Em±	0.15
LSD (P = 0.05)	0.45

Table 2: Relative economics of wheat as influenced by integrated nutrient management practices

Treatments	Relative economics (₹ ha ⁻¹)			
	Cost of cultivation	Gross returns	Net returns	B:C ratio
Control	16000	51140	35140	2.20
50% RDF (60-30-30 kg N-P-K ha ⁻¹)	17819	67740	49921	2.80
75% RDF (90-45-45 kg N-P-K ha ⁻¹)	18729	75500	56771	3.03
100% RDF (120-60-60 kg N-P-K ha ⁻¹)	19638	80970	61332	3.12
50% RDF + FYM 3 t ha ⁻¹	19319	75450	56131	2.91
75% RDF + FYM 3 t ha ⁻¹	20229	80990	60761	3.00
100% RDF + FYM 3 t ha ⁻¹	21138	86970	65832	3.11
50% RDF + FYM 2 t ha ⁻¹ + VC 1 t ha ⁻¹	19819	79440	59621	3.01
75% RDF + FYM 2 t ha ⁻¹ + VC 1 t ha ⁻¹	20729	91400	70671	3.41
100% RDF + FYM 2 t ha ⁻¹ + VC 1 t ha ⁻¹	21638	92060	70422	3.25

Conclusion

On the basis of one year experiment it may be concluded that application of 100% RDF + FYM 2 t ha⁻¹ + VC 1 t ha⁻¹ recorded significantly higher protein content in wheat grain along with gross returns. However, higher net returns and B:C ratio were recorded with application of 75% RDF + FYM 2 t ha⁻¹ + VC 1 t ha⁻¹ under the agro-climatic condition of Saharanpur, Uttar Pradesh.

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